

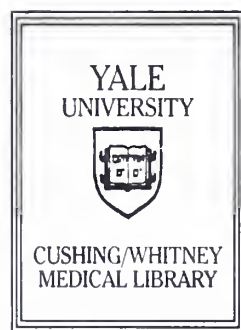
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SMOKING BEHAVIOR AND HEALTH BELIEFS
IN ADOLESCENTS WITH ASTHMA

Amy Elizabeth Taylor

Yale University

1998



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**Smoking Behavior and Health Beliefs
in Adolescents with Asthma**

A Thesis Submitted to the
Yale University School of Medicine
in Partial Fulfillment of the Requirements for the
Degree of Doctor of Medicine

by
Amy Elizabeth Taylor

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SMOKING BEHAVIOR AND HEALTH BELIEFS IN ADOLESCENTS WITH ASTHMA.

Amy E. Taylor (Sponsored by Walter R. Anyan). Section of Adolescent Medicine, Department of Pediatrics, Yale University, School of Medicine, New Haven, CT.

The purpose of this study is to compare the prevalence of cigarette smoking and the beliefs about tobacco use in adolescents with asthma to those without respiratory disease. A total of 103 adolescents were surveyed, ranging in age from 13 to 17, using a written questionnaire and a brief verbal interview. Subjects were recruited from the Adolescent Clinic of the Yale Primary Care Center, the Pediatric Pulmonary Clinic, and the New Haven Detention Center. Results were analyzed using adjusted odds ratio, chi-square, and T-tests. We found a smoking prevalence of 40%, and overall, asthmatics and nonasthmatics had similar prevalences of smoking. However, when the severity of asthma was taken into account, we found that moderate/severe asthmatics had a smoking prevalence of 25%, compared to 48% of those with mild asthma. The participants' knowledge about the health risks of tobacco use was examined using a series of questions that were graded on a five-point scale, with a higher score reflecting more awareness of the dangers of smoking, and a more negative opinion of tobacco use overall. We found no significant difference in the health belief scores between either of the asthmatic groups and the nonasthmatics. Another interesting result was the similarity of scores between the smokers and the nonsmokers. We conclude that, in contrast to our hypothesis, asthmatic teenagers are not more educated about the risks of smoking, and are not more likely to be nonsmokers. In addition, the lack of correlation between smoking status and health belief score, indicates that simply providing adolescents with facts does not deter them from smoking.

ACKNOWLEDGMENTS

I would like to acknowledge Dr. Walter Anyan for his sponsorship and support, and also Dr. Carol Rosen for her input and help from the Pulmonary Section of the Department of Pediatrics.

I would also like to thank the Office of Student Research for financial support of this project.

TABLE OF CONTENTS

	Page
Introduction	
Asthma	1
Adolescent Smoking	4
Smoking and Asthma	10
Statement of Purpose	12
Methods	
Study sample	13
Survey	13
Results	16
Discussion	
Prevalence of smoking	23
Health belief scores	27
Conclusions and implications	29
Appendix 1	33
References	36

INTRODUCTION

Asthma

Reactive airway disease, or asthma, is one of the most common causes of chronic illness in childhood. It accounts for more missed school days than any other single disease and interferes with participation in a wide variety of physical activities. Even more serious is the mortality associated with asthma. It is estimated that in persons under sixty years of age, the annual death rate from asthma is 1/100,000. A child is at increased risk of having a fatal asthma attack if there is a history of severe, steroid-dependent reactive airway disease, or if the child or family has difficulty recognizing the warning signs of a severe attack. For this reason, children who live in dysfunctional or very disorganized family situations may be at higher risk. Asthma is more common in African-American children, although the etiology of this is not clearly delineated. African-American children also tend to have higher rates of hospitalization for asthma exacerbations, and this seems to be associated more with poverty than with race, as children in other ethnic groups from similar socioeconomic levels have comparable rates of hospitalization. The incidence of asthma has been increasing across all ethnic groups over the past decade. Many attribute this trend to increasing levels of air pollution, although many factors are likely involved.

Asthma is a complex disease involving airway hyper-reactivity and a chronic process of inflammation within the airways, including hypersecretion of mucus, mucosal edema, and desquamation of epithelial cells. Asthmatics have been found to have hypertrophy of bronchial smooth muscle

and mucus glands. The pattern of bronchial constriction and inflammation is initiated when mast cells are stimulated to release a variety of inflammatory factors. The trigger for this release may be nonspecific stimulation of the mast cells directly, or may be linked to a specific antigen binding to immunoglobulin (IgE). Mast cells release mediators such as histamine, leukotrienes and platelet activating factor, setting up a cascade of bronchial constriction and inflammation. Because of the chronic inflammatory component of asthma, many patients with reactive airway disease require daily treatment with steroids or a mast-cell stabilizer (such as cromolyn), in addition to B₂-receptor agonists for acute episodes.

The etiology of asthma is not completely understood, as many factors seem to contribute to the development of the disease. There is certainly a genetic component to reactive airway disease, as children with one parent with asthma have a 25% chance of being asthmatic, while the risk increases to 50% if both parents have asthma. Many persons with asthma have higher baseline levels of IgE than do people without asthma, which is one possible mechanism for the genetic predisposition to asthma. Swedish investigators have found that a high concentration of IgE in the cord blood of newborns predicts a 75% incidence of atopic disease before the age of one, and an 82% incidence of atopic symptoms before the age of seven.¹ However, twin studies have shown that although genetic factors are clearly involved in the development of reactive airway disease, environmental factors seem to play an even bigger role.

Environmental factors have been implicated in both precipitating acute asthma attacks, and in the initial development of asthma. Studies with monozygotic twins found only a 19% concordance rate when one twin had reactive airway disease.¹ This relatively low rate of concordance implies that

a large proportion of the risk of developing asthma has to do with environmental factors, such as exposure to dust mites, animals, pesticides, and tobacco smoke. Many environmental triggers stimulate the airway to constrict and cause inflammatory mediators to be released. Some of these triggers include dust mites, pollen, cold air, exercise, cigarette smoke, and viral respiratory infections.² Individuals may have certain allergens to which they are particularly sensitive, but in some cases, it is difficult to elucidate the exact trigger of an asthma exacerbation.

Treatment of asthma has traditionally focused on prevention and management of acute exacerbations, including avoidance of known triggers, such as animal dander, dust mites in the home, or cigarette smoke. There is clear evidence that using plastic mattress/pillow covers or other household interventions greatly reduces airway hyper-reactivity in children with asthma.¹ Acute attacks are treated pharmacologically with B₂-receptor agonists, such as albuterol, and a short course of steroids may be given to reduce airway inflammation. Primary prevention of asthma is less well studied, but there are some indications that in certain children clinicians may be able to alter the risk of developing asthma. It is known that a child is at higher risk for developing asthma if his/her mother smoked during the pregnancy. It is also thought that reducing a child's exposure to antigens, especially during the first year of life, will reduce the risk of developing reactive airway disease, or other atopic disorders.

Asthma may have its onset at any age, but most children who are diagnosed with asthma have become symptomatic by the age of four or five. There is a wide range in the severity of the disease, from occasional wheezing with a viral infection to persistent, debilitating, respiratory compromise. Although it is a commonly held belief that children will "outgrow" their

asthma, this is not the case for many children. Adolescents are affected by reactive airway disease almost as frequently as are younger children, and in fact, asthma is more common among teenagers than it is among adults.³ Being asthmatic is a psychological stress for any child and family, but it may be especially difficult for the adolescent with asthma to cope. At a time when the teenager is trying to become independent from his/her family, parents may still be accompanying the child to doctor's visits, and may be more involved in the treatment plan than the adolescent might want. The teenage years also are a time when it is very important to fit in with peers. Having to refrain from physical activities or to use an inhaler places the adolescent in a position of being seen as different from his/her peers. For this reason, adolescents with asthma may undergo more psychological stress than other teens, and may become less compliant with their treatment plans.

Adolescent Smoking

Cigarette smoking is the largest preventable cause of disease and premature death in the United States.⁴ Smokers have poorer exercise tolerance and weaker immune systems than do nonsmokers. One of the major consequences of smoking is an acceleration in the rate of atherosclerotic cardiovascular disease. Coronary heart disease is one of the leading causes of death in the United States, and it is estimated that cigarette smoking accounts for about 20% of these deaths. Along similar lines, smoking increases a person's risk for a fatal stroke, in a dose-response relationship. Cigarette smoking is the single most important cause of cancer mortality in the United States, with more people dying each year from lung cancer than from any other tumor. The effects of smoking on respiratory function are well-demonstrated as well, with cigarette smoking leading to COPD (chronic

bronchitis and emphysema), and other respiratory symptoms. Smokers are much more likely to have symptoms of chronic cough, sputum production, and breathlessness than are nonsmokers. People who smoke are more likely to have abnormal pulmonary function tests, including measurements of elastic recoil, diffusion capacity, and airflow. Even adolescent smokers demonstrate some degree of airflow obstruction. In addition to these respiratory problems, it has been documented that smoking during pregnancy leads to lower birth-weight babies (by about 200g), and that the infants are much more likely to develop asthma during the first few years of their lives. Cigarette smoking is obviously a significant public health concern, and it is an arena in which clinicians can make a large impact on the health of many people.

Public health campaigns waged over the past few decades seem to have made some impact on the problem. Prevalence of smoking in adults has dropped by 34%, and more of working and social environments in the United States are becoming smoke-free. Unfortunately, a similar trend has not been seen among adolescent smokers. Although the teenage smoking initiation rate had declined from 1980 to 1984, from 5.4% to 4.7%, the next five years saw a slight increase in the rate of smoking initiation among adolescents, with the rate going up to 5.5%.⁵ Some attribute this rise to the increase in marketing campaigns by the tobacco companies, especially those campaigns that seem to target adolescents or young adults in particular. The tobacco companies' budget for promotional advertising and specialty item distribution increased by 264% from 1984 to 1990.⁶ A specific concern exists for teenage girls, as the prevalence of smoking in this group in the United States has exceeded that among teenage boys each year since 1977.⁷ This gender difference is in contrast to statistics from Korea and other East Asian countries, where studies indicate that smoking is much more prevalent among boys than among girls.⁸

The trends also have not been equivalent for all ethnic groups. In fact, the rate of cigarette smoking among African-American adolescents consistently declined from 1980 to 1991, and by 1985 white teenagers were more likely to smoke than were African-American teens.⁶ The decline in the prevalence of cigarette smoking among adolescents has slowed considerably, and there are some indications that rates may actually be on the rise again. For this reason, it is important to continue to study the factors that influence a teenager's decision to begin smoking.

One behavioral model of smoking identifies three distinct stages that a person may go through in becoming a smoker. These include: the initiation stage, the experimentation stage, and the habitual use stage.⁴ The initiation stage involves the first few cigarettes that a person tries, usually in adolescence. Evidence suggests that early physiological response to cigarettes may greatly influence whether a person moves on to the next stage. The period of experimentation may be thought of as a transitional period, lasting for a few years. There seems to be an association between the amount of smoking done during the experimentation phase and the likelihood of becoming a habitual smoker. For this reason, smoking cessation programs during adolescence might reduce the number of teenagers who go on to become regular adult smokers. In the past, adolescents have not been the focus for most smoking cessation programs, but a recent study has shown that the issues surrounding teenage smoking (including psychological and physical addiction) are very similar to those found in adults.⁷ These results indicate a need to rethink the approach to teens who are already smoking fairly regularly. Another study that examined transitions to smoking during adolescence found that the move from one step to the next was largely irreversible, with occasional smokers rarely reverting to being nonsmokers,

and regular smokers not often going back to occasional use.⁹ The initiation of smoking may be happening at an earlier age than is widely recognized, and early smoking raises an adolescent's risk for becoming a habitual smoker. A study conducted in New Zealand found that smoking by the age of eleven was the strongest predictor of later smoking behavior.¹⁰

Many factors have been shown to influence the initiation of smoking in adolescents. The experience of psychological stress is well-accepted during the teenage years, and a link between stress and increased consumption of cigarettes among established smokers has been demonstrated in adolescents, as well as in adults. In fact, one study has even shown an association between stress levels and smoking initiation in teenagers.¹¹ This study reveals much higher levels of stress among female adolescents, which mirrors the higher prevalence of smoking among teenage girls than among boys.

The influence of family and friends has long been seen as a major factor in a child's decision to begin smoking. Large-scale studies have confirmed this hypothesis, and have emphasized the additive effects of these two groups, which provide social reinforcement or punishment for use or abstinence, as well as providing role models whose behavior is imitated.¹² This influence may be either towards smoking or nonsmoking behavior, with both smokers and nonsmokers reporting that they have been influenced by friends and family.¹³ One particular study of smoking within and between clique groups has found that smoking is much more frequent among teens who are not part of a clique.¹⁴ This implies that it is actually nonsmoking behavior which is modeled and perpetuated within the cliques. A study in New Zealand discovered that a surprising 26% of students were active in promoting nonsmoking in school and among their friends.¹⁵ Another study looking at gender differences in the influence of peer groups has demonstrated that peer

relationships have a stronger impact on females than on males. The author hypothesizes that females tend to have smaller peer groups, and tend to be more conforming to the group than do males, who seek to assert status and to be more independent.¹⁶ The influence of peer and family groups may have more to do with the children's perception of the attitudes of these groups than with the actual opinions of the parents and friends. One study found a close correlation between the smoking status of a teenager and his/her report of parents' and friends' attitudes towards smoking.¹⁷ However, it is difficult to elucidate whether this represents a skewed viewpoint on the part of the teen, or whether these attitudes have truly influenced his/her decisions about smoking. The importance of peer and family circles as an influence on smoking behavior may be closely linked to specific cultural groups. A study conducted in Los Angeles and in San Diego examined a number of factors for their relative importance in influencing smoking. Among white teenagers, the number of peers who smoked was the best predictor of smoking status, while for black teens, this was not a predictor at all. Instead, risk-taking tendency was the strongest predictor of smoking status. The results for Hispanic adolescents were mixed - those who were the most acculturated had results similar to the white students, while those who came from homes where only Spanish was spoken had a profile which closely mirrored the black adolescents.¹⁸

As mentioned previously, the media has had a large influence on the choices that teenagers make about smoking. The huge increase in advertising budget, especially for Camel and Marlboro cigarettes, has clearly affected adolescents, with more teens listing these labels as their brand of choice. One recent study on the influence of tobacco marketing on adolescents has found that there is a strong association between a teenager's receptivity to tobacco

marketing and his/her susceptibility to begin smoking.¹⁹ This influence was found to be even stronger than that of exposure to other smokers.

Attitudes and beliefs about the health risks of smoking certainly influence an adolescent's decision to commence smoking. If teens understand the detrimental effects of smoking on their health, they will be less likely to begin smoking, in contrast to someone who believes that some benefit will come from cigarette smoking. A study of Hispanic adolescents found that those who held positive beliefs about smoking were 2-4 times as likely to become smokers as those who held negative beliefs about smoking.²⁰

In 1994, the Surgeon General of the United States addressed the problem of tobacco use in adolescents for the first time. A number of conclusions were reached, based on many years of clinical research, and recommendations and goals were set for the remainder of the decade.²¹ It was recognized that most adult smokers first tried tobacco as a teenager. Therefore, it is this time in development when clinicians have the opportunity and the responsibility to intervene with smoking prevention programs. It was also realized that most adolescent smokers are addicted to nicotine. This readily accepted concept for the adult smoker, had been overlooked as a significant issue for teenagers. It is important that this physiological dependence is addressed as clinicians develop smoking cessation programs for adolescents. Cigarette smoking often acts as the gateway drug that leads to use of illegal and more dangerous substances. A recent study by Luis G. Escobedo, et. al. found that marijuana use, binge drinking, and fighting are all correlates of cigarette smoking among American adolescents.²² This finding only serves to underscore the importance of addressing this vital public health issue. As has been discussed in many clinical studies, there are known psychosocial risk factors for smoking initiation in teenagers, and the influence of tobacco marketing

campaigns has been well-documented. This information should be used to reduce the susceptibility of adolescents to the lure of smoking initiation. Community-based efforts to decrease the prevalence of smoking among teens have been successful, to some degree. In particular, increasing the cost of cigarettes has a dramatic effect on the number of adolescents smoking, as was seen in Canada, with a 62% reduction in the prevalence of adolescent smoking.²¹ In Minnesota, a statewide antismoking campaign increased the students' exposure to antismoking messages, but did not change their smoking-related beliefs or their behavior.²³ Obviously, further measures are necessary to achieve the goal of the national health objective for the year 2000, which is to reduce cigarette smoking by children and young adults so that no more than 15% of them will be regular smokers by the age of 20.⁶

Smoking and Asthma

As important as smoking prevention is for adolescents at large, it is even more vital for those with reactive airway disease. It is well-established that exposure to environmental tobacco smoke can aggravate asthma and cause acute exacerbations. Recent studies have demonstrated acute respiratory effects following cigarette smoking in all adolescents. Cigarette smoking during adolescence appears to reduce the rate of lung growth and retard the final lung functions that can be achieved.²⁴ In addition, cigarette smoke has been shown to cause increased resistance to airflow in the lung, irritation of the airways, cough, and damage to the respiratory cilia. A recent study in the New England Journal of Medicine found that even small amounts of cigarette smoking in adolescents caused deficits in both FEV₁/FVC and FEF₂₅₋₇₅, which are measurements that indicate early stages of airway obstruction and small-airway disease.²⁵ People who smoke cigarettes have greater numbers and

increased activity of alveolar macrophages and have more airway permeability to large and small molecules.²⁶ These factors may lead to greater antigenic sensitization and immune response to stimuli. For asthmatics, whose immunologic respiratory response is already heightened, this exposure will certainly worsen their symptoms. Scott T. Weiss describes what he calls the "healthy smoker effect," which explains that asthmatics will have lower rates of smoking because their bronchoconstrictive symptoms become much more severe if they attempt to smoke cigarettes.²⁶ A study of children with homozygous alpha-1-antitrypsin deficiency found that they were significantly more likely to be nonsmokers than were age-matched controls. This lower rate of smoking may be a result of self-limitation based on their respiratory symptoms, but the author theorizes that this difference is due to education about their disease and its consequences.²⁷ The question, therefore, arises as to whether similar education about respiratory health exists among asthmatics, and whether such education influences their behavior and attitudes toward tobacco use.

STATEMENT OF PURPOSE

The hypothesis upon which this study was based is that adolescents with a chronic respiratory illness such as asthma would see themselves as more vulnerable to respiratory problems, and, therefore, would be more aware of the negative health consequences of smoking. This awareness would translate into a lower prevalence of smoking among asthmatics, and a more negative opinion of smoking overall. The purpose of this study is to compare the prevalence of smoking in a group of asthmatics to the prevalence in a control group. The attitudes of these groups toward tobacco use also will be investigated to determine if there is a significant difference in the health beliefs held by asthmatics as compared to nonasthmatics.

METHODS

Study sample

Subjects aged 13-17 were recruited at the Adolescent Clinic at the Primary Care Center at Yale-New Haven Hospital, as well as from the Pediatric Pulmonary Clinic at Yale-New Haven Hospital and the New Haven Juvenile Detention Center. Both asthmatics and nonasthmatics were approached at the Adolescent Clinic and the Detention Center, and only asthmatics were invited to participate at the Pulmonary Clinic. The purpose of the study was explained to potential subjects, and written, informed consent was obtained. When the subjects were less than sixteen years old and a parent was present, parental written consent was also obtained.

Survey

Current literature on smoking in adolescents was reviewed, and those investigators were contacted who had utilized a questionnaire to assess smoking behavior and health beliefs in teenagers. Four researchers responded, and sent copies of their surveys.^{23,17,6,26} A composite questionnaire was developed, based on some of the questions from these previously tested surveys. We included demographic questions, items that investigated exposure to smoking in family and friends, questions that addressed asthmatic status and influence of smoking on asthmatic symptoms, and a set of questions assessing the subject's level of understanding of the health risks of smoking. A copy of the questionnaire is included as Appendix 1.

The P.I. administered the questionnaire to all subjects in a private room to ensure confidentiality. Participants were given the choice of completing

the written survey themselves or having the investigator read the questions out loud and note their answers. Following the written questionnaire, a brief verbal survey was given, exploring the adolescents' opinions on the subject of teenage smoking and intervention programs. Those teens who identified themselves as asthmatic were also questioned as to their medication regimens, and symptom patterns. This information was used to divide the subjects into three groups: those without asthma, those with mild asthma, and those with moderate to severe asthma. Mild asthma was defined as that not requiring any chronic medication, and only needing B₂-agonist therapy 1-2 times per week or less. The subject must also be free of symptoms such as night-time cough, or persistent wheezing, which might indicate that they were being undertreated. Use of daily medication, such as steroid inhalers, the requirement of B₂-agonist therapy more than twice per week, persistent symptoms, and any history of intubation or ICU admission for asthma placed a subject into the moderate to severe asthmatic category. For those participants who were not sure about their asthma status, we reviewed their medical records to place them into one of the above categories (for the most part, these subjects did not carry a diagnosis of asthma).

The responses to the thirteen questions about the health risks of smoking were recorded on a five-point scale, with numerical values assigned corresponding to the level of health awareness that the subject demonstrated. Therefore, a higher "score" revealed a person who was more cognizant of the health risks of smoking, and who held a more negative view of smoking overall. The maximum health belief score was 65. These questions (and scores) were added to produce one composite health belief score, which could then be compared between the different groups being studied.

Statistical analysis was performed including chi-square tests to determine the influence of various environmental factors on the smoking status of adolescents surveyed. The smoking status of subjects as related to their asthmatic status was examined using chi-square tests as well as odds ratio calculations. Finally, the student's t-test was applied to elucidate whether the difference in health belief scores between groups was statistically significant.

RESULTS

A total of 103 adolescents completed the written questionnaire and were verbally interviewed. Most subjects were recruited from the Adolescent Clinic (81%), but participants were also enrolled from the New Haven Detention Center (13%) and from the Pediatric Pulmonary Clinic (6%). The sample was balanced by gender, with 44% males and 56% females, and the demographics of age and race are specified in Table 1. The subjects had a mean age of 15.2 and the sample had a normal distribution from age 13 through age 17. The racial composition of the group was sixty-five African-Americans, twenty Hispanics, eleven Caucasians, and five who identified themselves with another group.

Table 1. Subject population

	n (%)
Number of Subjects	103
Gender	
Male	45 (44%)
Female	58 (56%)
Age	
13	10 (10%)
14	17 (17%)
15	34 (33%)
16	26 (25%)
17	16 (15%)
Race	
African-American	65 (63%)
Hispanic	20 (19%)
Caucasian	11 (11%)
Other	5 (5%)
Smoking Status	
Daily	15 (15%)
Occasional	26 (25%)
Nonsmoker	62 (60%)

This distribution is fairly representative of the ethnic distribution of the indigent New Haven population. Table 1 also illustrates the overall prevalence of smoking in the group. Fifteen percent of the adolescents report being daily smokers, twenty-five percent report occasional smoking (at least once within the past year, but less than daily), and sixty percent are nonsmokers. When the number of smokers was broken down by gender, we found that the prevalence of smoking was slightly higher among girls, with 41% of them being smokers, compared to 38% of the boys. When the rates of smoking were compared among ethnic groups, we found that 40% of the African-American adolescents were smokers, 50% of the Hispanic teens were smokers, 36% of the

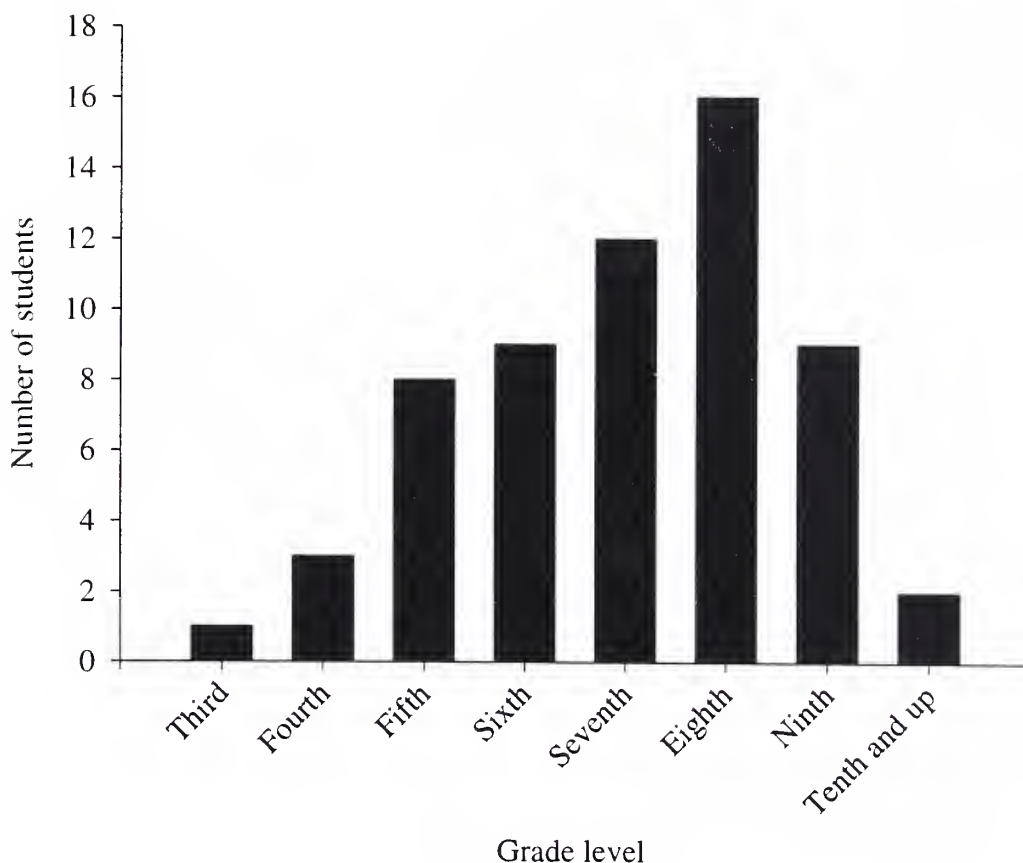


Figure 1. Grade level at which subjects report initiating smoking.

Caucasian subjects smoked, and 20% of those who identified themselves as belonging to another racial group were smokers.

The 41 smokers were asked to recall during in which grade in school they had begun to smoke. Figure 1 illustrates those results, with most subjects reporting that they began to smoke in eighth grade, followed by seventh grade as the second most common answer. The number of adolescents who initiated smoking in ninth grade was the same as those who began smoking in sixth grade, and a similar number recalled the beginning of their smoking as being in fifth grade. A small number of subjects reported initiating smoking in the tenth grade or beyond, and there were even a few teenagers who had started smoking in the third or fourth grade.

Our study found that there was a strong correlation between the subject's smoking status and the smoking status of their best friend. Table 2 reveals these results, with a chi-square value of 25.74, and $P < 0.01$. Similarly, the number of smokers at home was related to the subject's smoking status,

Table 2. Relationship of subject smoking status to best friend's smoking status, number of smokers at home, and rules about smoking at home

	Smokers	Nonsmokers	χ^2	P
Best friend does not smoke	10	46	25.74	< 0.01
Best friend smokes	31	15		
0-1 smokers at home	12	51	28.81	< 0.01
2 or more smokers at home	29	11		
Smoking not permitted at home	16	34	15.87	< 0.01
Smoking permitted at home	19	5		

with a chi-square value of 28.82, and $P < 0.01$. The rules about cigarette smoking at home were also significantly correlated with the subject's smoking status, having a chi-square value of 15.87, and $P < 0.01$. The correlation between the rules about smoking at school and a subject's smoking status were not found to be statistically significant. Table 3 compares the prevalence of cigarette smoking among adolescents with moderate/severe asthma, mild asthma, or no asthma. The group of teenagers with moderate/severe asthma has the lowest rate of smoking, with only 25% of the subjects reporting themselves as smokers, at least occasionally. The subjects without asthma were found to have a smoking prevalence of 43%, and the group with mild asthma actually had the highest smoking rate (48%). The odds ratio for smoking was calculated for both the moderate/severe asthmatics and the mild asthmatics as compared to the nonasthmatics. Mild asthmatics were more likely to smoke than nonasthmatics [OR = 1/.8; 95% CI (.309, 2.07)], while moderate/severe asthmatics were less likely to smoke [OR=1/2.23; 95% CI (.765, 6.5)]. Neither of these results was statistically significant. When a chi-square test was performed on the data, grouping all asthmatics together, a value of 0.365 was obtained (the critical value was 3.841), making the $P > 0.05$. Therefore, we cannot reject the null hypothesis that smoking status and asthma status are independent variables.

Table 3. Smoking prevalence among asthmatic groups

	Mod/Sev Asthma (%)	Mild Asthma (%)	No Asthma (%)
Nonsmokers	18 (75%)	13 (52%)	31 (57%)
Smokers	6 (25%)	12 (48%)	23 (43%)

Odds ratio, no asthma vs. mod/sev asthma = 2.23 [95% confidence intervals: (0.765, 6.50)]

Odds ratio, no asthma vs. mild asthma = 0.8 [95% confidence intervals: (0.309, 2.07)]

$\chi^2 = 0.365$, $P > 0.05$

The questions about the health risks of smoking were pooled, and each answer was assigned a value, on a scale from 1-5. The higher values represented answers that revealed more awareness of the dangers of smoking, and a more negative overall view of cigarette smoking. There were thirteen questions, so the lowest possible score was 13 and the highest was 65. The smokers as a group had an average score of 45.46, while the nonsmokers had a score of 47.65. When the smokers were broken down into daily and occasional smokers, the scores were 44.0 and 46.3, respectively. Among asthmatics, the nonasthmatics' average score was 47.02, the mild asthmatics' average was 45.32, and the moderate/severe asthmatics had an average of 47.75. Figure 2 shows the relation of these scores along a continuum. A one-tailed T-test was performed to compare the health belief scores of these groups. The result was -1.671, with a critical value of -1.658, making $P > 0.05$. This shows that the differences in scores between all of these groups are not statistically significant.

The subjects who had a best friend who smoked, who had many smokers

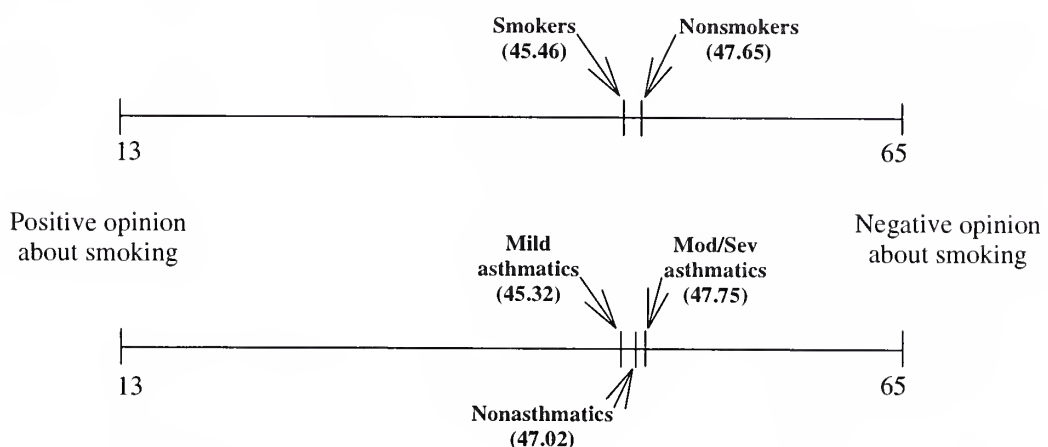


Figure 2. Health belief scores for smokers, nonsmokers, asthmatics, and nonasthmatics. $P > 0.05$ for all pairs, as determined by Student's *t*-test.

in their home, and who were allowed to smoke at home or at school did not have markedly different health belief scores than subjects who did not report these factors. We also looked at the health belief scores grouped by age, to determine whether a trend could be detected based on age. The scores were remarkably similar, with the exception of slightly lower scores for the fourteen year-olds. The thirteen year-olds had an average score of 48.2, the fourteen year-olds' mean was 42.5, and the fifteen, sixteen, and seventeen year-olds had scores of 47.2, 47.3, and 48.6, respectively. One particular question on the survey addressed the commonly held belief that smoking helps a person to lose weight. Table 4 reports the results of this question, with the answers divided by gender. An equal percentage of males and females disagreed with the statement that smoking aids in weight loss, but nearly twice as many girls agreed with the statement as did boys (the rest of the boys answered "I don't know" to the question).

The final part of the survey was a verbal question posed by the investigator, who asked each participant, "Why do you think so many teenagers smoke?" This question was asked of all subjects, whether or not they smoked. Figure 3 illustrates their responses, grouped into major categories. The most common answer by far was "Peer pressure," with forty-one percent of the subjects stating this was the reason that so many adolescents smoke. The next most common answer, at twenty-one percent, was "example of parents

Table 4. Responses to the statement "smoking helps weight loss"

	Male (%)	Female (%)
Agree	7 (16%)	15 (26%)
Disagree	16 (36%)	20 (35%)
Don't know	22 (48%)	22 (38%)

and friends." Thirteen percent of the subjects reported "stress" as the reason for smoking, and along a similar vein, nine percent of the teens stated that adolescents smoke "to relax." The remaining mixture of answers included: "something to do," "to look older," "the buzz/good feeling," "for fun," "to get attention/rebel," and "curiosity."

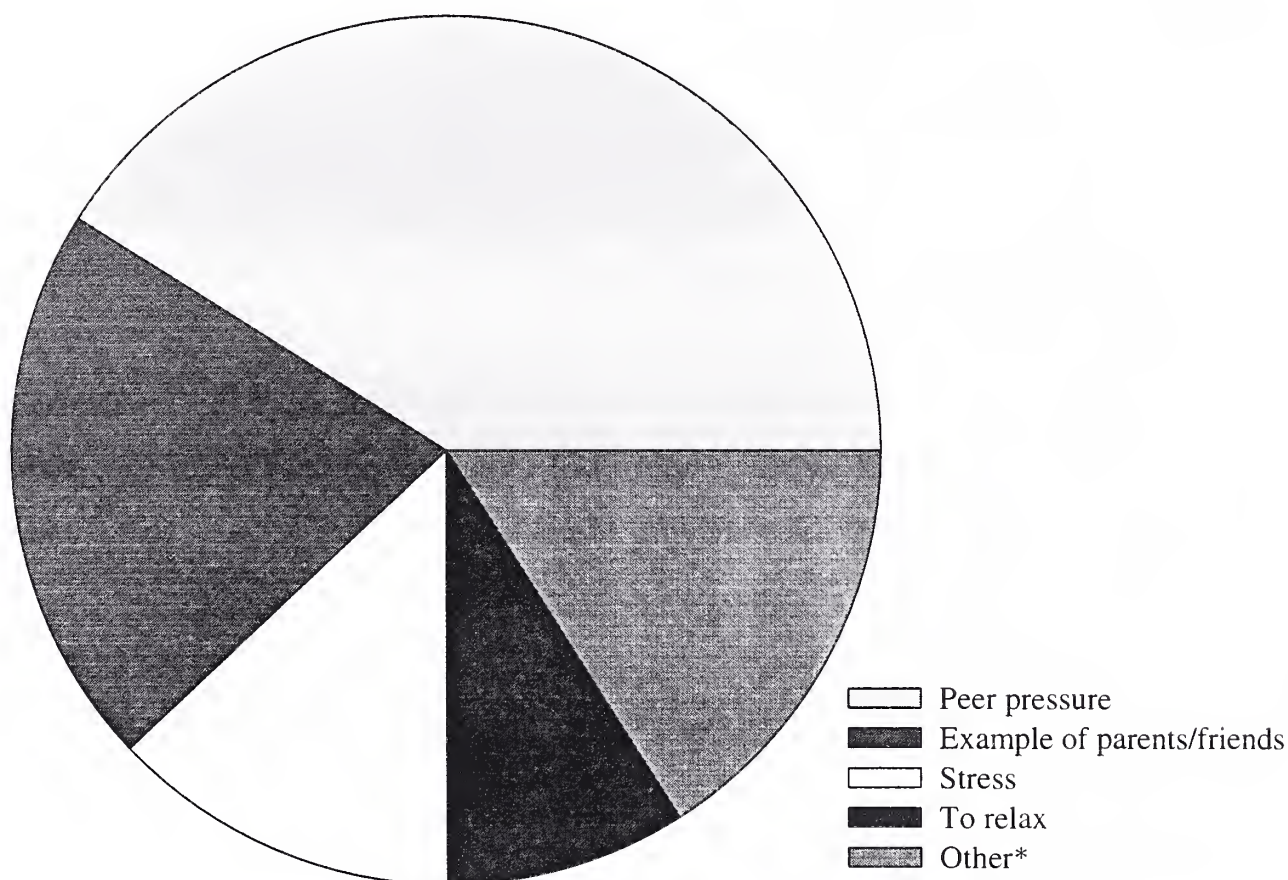


Figure 3. Reasons given by adolescents for smoking cigarettes.

* includes "something to do," "to look older," "the buzz/good feeling," "for fun," "to get attention/rebel," "curiosity."

DISCUSSION

Smoking Prevalence

This study has found a somewhat higher prevalence of smoking among a subset of adolescents in New Haven than that reported in other surveys, many of which have used a sample much more representative of the national population. Prevalence of cigarette smoking among adolescents has been noted to be anywhere from 10% to 35%, depending on the study quoted^{4,6,7,8,12,16,17,21}, but some have used populations outside of the United States. The prevalence of current cigarette smoking among high school students in the United States was found to be 34.8%, based on the 1995 CDC Youth Risk Behavior Surveillance System,²⁸ which is somewhat lower than the 40% rate found in this study. There are many reasons that may account for this difference, including the fact that a much smaller sample size was used in this study than is used when national surveys are utilized. The New Haven adolescent population is not representative, ethnically or socioeconomically, of the adolescent population in the United States at large. More specifically, some of the subjects were recruited from the New Haven Detention Center, which could skew the results toward teens who exhibit more risk-taking behavior. Also, the Adolescent Clinic mainly serves teenagers from lower socioeconomic levels, who often come from disorganized family situations, and may be at higher risk for smoking.

Another factor that may have contributed to the high prevalence of cigarette smoking found among New Haven adolescents is the broad definition of current smoking used when analyzing the data. Any teenager who reported smoking during the previous year was considered a smoker, whether they

smoked daily or only occasionally. This definition was chosen because previous studies indicate that once an adolescent has begun to experiment with smoking, a large percentage of them will progress to become habitual smokers. The risk for becoming a regular, adult smoker was doubled in those teens who had "tried a few cigarettes."⁴ For this reason, it seems important to include even those teens who are only smoking occasionally in the "smoker" group. Another consideration in using a generous definition of "smoker" is that teenagers tend to under report tobacco use, especially in a situation where they may sense disapproval of smoking behavior. Certainly, a survey being conducted in a medical clinic could discourage adolescents from being honest about their tobacco use, despite clinicians' attempts to create a confidential and safe environment.

Our study found the prevalence of smoking to be slightly higher among adolescent girls than among adolescent boys (41% as compared to 38%). This subtle difference corresponds to the results of many other studies. A survey based in Canada reports that adolescent females now have the highest rates of smoking of any age-gender group.¹⁶ It is interesting that such a difference exists in our data, when many of the male subjects were recruited from the New Haven Detention Center, where one might expect higher rates of smoking. Despite this possible bias for raising the prevalence of smoking in males, the females were still found to have higher rates of cigarette smoking. Of the many theories used to explain the gender differences in adolescent smoking prevalence, one of the most plausible involves the model of peer influence as a very important factor in smoking initiation and continued smoking behavior. Girls tend to have smaller, more tightly-knit friendship groups, and have been found to be more conforming to the group than are boys.¹⁶ Because of the strong influence that peer groups have on female

adolescents, they may be more likely to begin smoking when exposed to friends or family members who smoke. This may help to explain why the prevalence of smoking has been higher for adolescent females than for males over the past decade. However, there has been a decline in the prevalence of smoking among adolescent females that has been greater than the decline among males. A possible explanation for this trend is said to be an increased perception of cigarettes as harmful as well as more conservative cultural norms.⁶

The distribution of smokers among racial groups was fairly equal, with slightly higher smoking prevalence found among Hispanic teenagers, and fewer Caucasian subjects smoking than the overall numbers would have predicted. This is in contrast to national statistics which reveal higher rates of smoking among Caucasian teenagers than among African-American teens. In fact, the prevalence of smoking in Black adolescents has been steadily declining over the past decade, while the rates of White adolescents who smoke have been stable or even increasing somewhat.⁶ The higher prevalence of smoking in the Hispanic subjects in our study cannot be clearly explained. Previous national studies have actually found lower rates of cigarette smoking in Hispanics teens, as compared to Caucasian or African-American adolescents. Because one study did find significant differences in factors that influence smoking initiation between highly acculturated Hispanics and those who retain more of the Hispanic culture, this may affect the results of smoking surveys. However, our questionnaire did not address the level of Hispanic culture (for instance, whether Spanish is the predominant language spoken at home), so it is difficult to determine if this was a factor which influenced the rate of smoking for Hispanic subjects.

Our study supports the findings of previous surveys, showing a strong correlation between the subject's smoking status and the smoking status of their best friend. We also demonstrated a relationship between the number smokers in the household and the subject's smoking status. Additionally, the rules about tobacco use at home are also related to the smoking status of the subject. In contrast, the rules about cigarette smoking at school were not significantly correlated with a subject's smoking status. These results underscore the important influence of friends, family and home environments in shaping an adolescent's decision whether or not to smoke.

One hypothesis which the survey set out to study was that adolescents with asthma would have lower rates of cigarette smoking than would teenagers without any respiratory problems. The hypothesis was based on the fact that smoking generally makes asthma symptoms worse, which is seen even with exposure to secondary smoke. It has been shown that children of parents who smoke have more frequent asthma exacerbations,¹ more peak flow variability, and poorer lung function,² and this effect can only be magnified when asthmatics smoke. The hypothesis is also based on the assumption that asthmatics would be more informed about the health risks of smoking. The results that we obtained did not support this hypothesis, except when those with moderate/severe asthma were studied separately from the mild asthmatics. We found that 25% of those with moderate/severe asthma were smokers, as compared to 48% of those with mild asthma, and 43% of those with no respiratory disease. The fact that the subjects who suffered from mild asthma actually had a higher prevalence of smoking than the nonasthmatics was truly surprising. This finding refutes the "healthy smoker effect" theory of Scott T. Weiss, which states that people with asthma may be unable to smoke, or may have to quit because of the increase in bronchoconstrictive

symptoms.²⁶ In fact, when asked specifically in our survey whether smoking increased the number or severity of asthma attacks, most respondents said that smoking made no noticeable difference in their respiratory symptoms. This response forces us to rethink our assumption that asthmatics or others with respiratory disease will self-regulate their use of cigarettes.

Health Belief Scores

The second part of our hypothesis was that adolescents with asthma would be better educated about the health risks of smoking, and would hold a more negative viewpoint of cigarette smoking in general. It was our thought that this would, in turn, translate to lower rates of smoking among teenagers with asthma. Just as our study found that the prevalence of smoking was essentially the same in asthmatics and nonasthmatics, the cumulative health belief scores for these two groups were not significantly different. Overall, teenagers with asthma were not more educated about the respiratory health risks of smoking, and did not hold a more negative opinion of smoking than did nonasthmatics. Although no studies have been published that look specifically at the health beliefs of adolescents with asthma, a parallel study focusing on children with alpha-1-antitrypsin deficiency (ATD) did find lower rates of smoking among the children with ATD as compared to controls. These results were attributed to the children's "awareness of the ATD and its consequences."²⁷ That study involved informing parents, and children themselves, about the risks of smoking for people with ATD. It does not seem too presumptive, though, to assume that similar education should be given to parents and children with asthma. Our results, however, indicate that

asthmatic adolescents have not received, or absorbed, any more information about the health risks of smoking than the average teenager.

A corollary to this hypothesis is that those adolescents who are better informed about the dangers of smoking will be less likely to make the decision to begin smoking. A study on the sociobehavioral influences on smoking initiation found that for Hispanic youths in particular, there was a strong correlation between health beliefs about tobacco and the initiation of smoking behavior. Subjects in that study were 2-4 times as likely to begin smoking if they held more positive beliefs about cigarette smoking.²⁰ Therefore, the smokers in the group that we studied should have scored lower on our health belief scale. This, however, was not the case. The scores for the nonsmokers as compared to the smokers were only slightly higher, and the difference was not statistically significant. The implication of these results is that simply providing adolescents with facts about the dangers of smoking does not alter their behavior or choices in a meaningful way. This is not such a revolutionary realization, as it is well-established that teenagers regularly engage in risk-taking behaviors, even when the possible consequences are known to them. Examples of this are plentiful and include drunk driving, engaging in unprotected intercourse, and the use of illicit substances. It is important to keep this in mind as clinicians design intervention programs to reduce the number of adolescents who smoke.

The question arises as to when in adolescence the knowledge about the health risks of smoking is obtained. One might expect the scores on the health belief survey to rise across the age groups studied, but in fact the thirteen year-olds had higher scores, on average, than the fourteen through sixteen year-olds. These results indicate that teenagers are being educated, to some degree, about cigarette smoking, and that this happens prior to the age of

thirteen. It is unclear whether the source of this information is home, school, pediatricians, or some other source such as television. It is appropriate that education seems to be given before the age of thirteen, as our survey found that the most common age to initiate smoking was thirteen, and children report beginning to smoke as young as eight years of age. This result is consistent with other studies that have found the mean age of smoking initiation to be thirteen.¹²

Specific survey questions are interesting individually. When subjects were asked whether smoking helps people lose weight, almost twice as many females agreed with this statement as compared to male subjects. This may not be surprising, as teenage girls tend to be more concerned with their weight. If the perception that smoking aids in weight loss is indeed common among female adolescents, it may contribute to the higher prevalence of smoking among teenage girls. Another commonly held myth is that the health risks associated with smoking apply to men more strongly than they apply to women.¹⁶ Women may feel that they are, to some degree, "immune" to the negative health consequences of smoking, and therefore, ignore many of the warnings.

Conclusions and Implications

The results of this study are somewhat disheartening, as they reveal that a large proportion of adolescents (at least in our sample) are smoking cigarettes, despite the well-established and fairly well-publicized health risks of smoking. The year 2000 health objective is to reduce the percentage of adolescents who are regular smokers by age 20 to 15%. Although only 15% of subjects in this study reported being daily smokers, another 25% state that

they smoke at least occasionally. This result is concerning, since many of the teenagers who are in the experimental phase of smoking will go on to become habitual smokers. This progression has far-reaching public health consequences, as the burden of this smoking-induced morbidity and mortality will fall on the American health care system in the years ahead. If the year 2000 health objectives are to be met, more effective interventions must be undertaken to prevent adolescents from beginning to smoke, and to help teens who are already regular smokers to quit. Certainly, parents retain a strong influence on adolescents' decisions to begin smoking, and therefore, must be included in the process of developing and implementing these programs. Before effective preventive programs can be designed, there remains a great need to understand the reasons behind adolescent smoking and the factors which influence their choices.

One important detail that was clear in our study is that the age at which children are beginning to smoke is lower than many people realize. Smoking prevention programs that are directed towards high school students are likely missing many teens who have already begun smoking, in eighth grade, seventh grade, or even earlier. To reach the greatest number of children, and make the most impact on this problem, education about tobacco use should begin in elementary school. This would give the children the necessary tools to face the difficult decisions about smoking when they first encounter them. It is certainly more effective to prevent teens from beginning to smoke than it is to develop smoking cessation programs for adolescents (although these are a vital component also).

The study we conducted revealed that simply providing facts about smoking to teenagers may not significantly alter their behavior regarding tobacco use. The smoking and nonsmoking subgroups of participants had

about the same amount of knowledge about the dangers of smoking, yet they had made very different decisions about cigarette smoking. Even more disturbing is the statewide study in Minnesota which found that a large antismoking campaign did indeed increase the adolescents' exposure to antismoking messages, but that it didn't change their beliefs about tobacco use or their smoking behavior.²³ The concept that more than straight data needs to be included in intervention programs for them to be effective is true for other problems in adolescence. Programs that address the issues of HIV, teenage pregnancy, and substance abuse are more successful when techniques such as peer teaching, behavioral models, and role playing are utilized. These principles should be kept in mind when designing smoking prevention programs for adolescents.

Our study also highlighted another important point, which is that asthmatics, a population at high risk for serious complications from smoking, do not seem to be any better informed about the risks of cigarette smoking than the average teenager. Pediatricians, parents, and teachers need to be aware of the need to target this group of teenagers with education about tobacco use. One problem, identified by John F. Price, may be that adolescents are underdiagnosed with asthma. He found a prevalence of asthma of 30% in New Zealand when using a written survey and videotaping techniques, while the statistic for "diagnosed" asthma in Australia is only 16.5%.³ Asthmatic teens may even be more susceptible to becoming smokers than other adolescents, because of increased levels of stress induced by the fear of being different. After many years of using an inhaler, or having to refrain from certain physical activities, the asthmatic teenager may feel an even greater need to "rebel" against his/her parents or doctors. Cigarette smoking might be seen as one way to finally fit into the crowd and gain acceptance by peers. For

this reason, clinicians should focus on providing adolescents with asthma the information they need about the risks of smoking, as well as the social coping skills necessary to make good decisions about tobacco use.

14. How acceptable is smoking to your friends at school? Really like it Like it Don't care Don't Like it Really don't like it

15. How acceptable is smoking to your family? Really like it Like it Don't care Don't Like it Really don't like it

16. If my friends wanted me to smoke and I didn't want to, I would... Have no trouble saying no Probably just smoke anyway Say no, but feel uncomfortable Not know what to do

17. What are the rules about smoking in your house?
 I can smoke anywhere in my house
 I can smoke, but only in certain rooms of the house
 I can smoke, but not around guests
 I can smoke, but not near my younger brother/sister
 I can smoke, but not around my parents
 I'm not allowed to smoke at home at all
 I don't know

18. What are your school's rules about smoking?
 Students aren't allowed to smoke anywhere on school property
 Students are allowed to smoke only outside building
 Students are allowed to smoke inside building, but only in the smoking area
 Students are allowed to smoke anywhere
 I'm not sure

19. Do you have asthma? Yes No Not sure

The following questions will give a statement, and you will be asked whether you agree strongly, agree, don't know, disagree, or disagree strongly.

20. If I smoked I wouldn't live as long. Strongly Agree Agree Don't Know Disagree Strongly Disagree

21. Cigarette smoke can hurt nonsmokers. Strongly Agree Agree Don't Know Disagree Strongly Disagree

22. Smoking can help you lose weight. Strongly Agree Agree Don't Know Disagree Strongly Disagree

23. If I smoked, it probably wouldn't hurt me.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
24. Just being around smokers is bad for your health.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
25. Smoking makes exercise or sports easier.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
26. Smoking will kill you.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
27. Breathing other people's smoke doesn't really bother your own health.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
28. Smokers need more Vitamin C than do nonsmokers.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
29. Smoking does not cause lung cancer.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
30. Smoking can't make breathing problems such as asthma worse.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
31. If I smoked, I would be more likely to get cancer.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
32. Cigarette smoking frequently causes disease and death.	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree

The final two questions are only for people who have asthma and smoke.

33. I notice I have _____ asthma attacks after I've been smoking.	Fewer	The same amount of	More
34. I have to use _____ asthma medication (inhalers) after I've been smoking.	Less	The same amount of	More

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